THE EFFECT OF SUGGESTION UPON THE REPRODUCTION OF TRIANGLES AND OF POINT DISTANCES

By J. CARLETON BELL
with the assistance of GRACE E. HATCH and LUCETTA T. OHR
[*From the Wellesley Psychological Laboratory.*]

HISTORICAL

It is generally recognized that every one is more or less influenced by suggestion. Experimental studies to determine the exact nature and amount of this influence, however, meet with considerable difficulty, owing to the artificial conditions which necessarily prevail in the laboratory. Especially is it difficult to devise a method of procedure which will afford an accurate measure of the effect of suggestion upon the reaction to visual stimuli.

Small,[1] in his study of the suggestibility of children, had a toy camel arranged with a rope around its neck in such a way that when he turned a windlass the suggestion was given that he was pulling the camel, though the latter did not move. Influenced by the suggestion 291 out of 381 pupils asserted that they saw the camel move. The percentage of effectiveness of the suggestion varied in the different grades tested as follows:

Grades	I	II	III	IV	VI	VII	Total
Percentage of illusion	96	81	80	70	34	71	76

The low percentage for VI is accounted for by the fact that the conditions were unfavorable for the illusion. In this experiment the mechanism of the windlass and the force of its pull were carefully explained beforehand and a high degree of expectation aroused, so that the asserted perception of movement was the result of the vivid idea.

Binet[2] reports an experiment, also on children, which is more closely allied to the present investigation. A line 50 mm. in length was shown by the director of a school to each pupil individually and the pupil was required to draw a line of equal length. In these reproductions there was a marked tendency to draw the line too short, seventy-eight out of eighty-six making it less than 50 mm. The reproductions varied in length from 28 mm. to 60 mm. The director then stated that

[1] Small, M. H.: The Suggestibility of Children, *Ped. Sem.*, Vol. 4, 1896, p. 182.
[2] Binet, A.: La Suggestibilitè. *L'Annèe Psych.*, Vol. 5, 1899, p. 99.

they would be shown a *longer* line, which they were to reproduce in like manner. The line which they were shown, however, was actually shorter, measuring only 40 mm. Only nine of the eighty-six drew the second line shorter than the first, and of these only one drew it 10 mm. shorter. In the case of the seventy-seven who followed the suggestion, the increase in the length of the second line over the first varied from 0 to 20 mm., with an average of 6 mm. The younger pupils showed a greater percentage of suggestibility than the older. The director then told them that they would be shown a third line a little *shorter* than the second, whereupon the original line of 50 mm. was presented again. This suggestion was less efficacious than the first, only seventy out of the eighty-six yielding to it. The amount of error was likewise reduced. Whereas in the first suggestion thirty-three showed a positive error of 5 mm. or more over the length of the original 50 mm. line, in the second only twenty-three showed as great a negative error below the 40 mm. line.

Pearce[1] tested the influence of a suggestive stimulus upon the extent of eye movements as indicated by visual localization. The subject, seated at the centre of a circle whose radius was 3½ feet, fixated a small square of white paper on the periphery directly in front of him. After 2 seconds another square was shown for 2 seconds at, *e. g.*, 30° to the right of the fixation point, and on its disappearance the subject turned his eyes to the point and indicated its location. As a suggestive stimulus a third square was shown 15° to the right or left of the second, the subject still keeping his gaze directed to the fixation point, and after the suggestive stimulus had disappeared the subject indicated the location of the second square. Five points were chosen from 30° to 69° to the right.

Without a suggestive stimulus there was an error of —0.4° to —6° (mean —3.2°), that is, the point localized was always to the left of the stimulus, the line of regard did not move far enough. When the suggestive stimulus was shown 15° to the *left* of the stimulus to be localized, the average error was —0.2° to —7.4° (mean —4.4°), showing a decided positive influence of the suggestion. When the suggestive stimulus was 15° to the *right* of the peripheral stimulus the average error was +1.2° to —6.5° (mean —2°), again showing a positive influence of the suggestion. Summing up his results Pearce notes that with a single peripheral stimulus the error toward the fixation

[1]Pearce, H. J.: Normal Motor Suggestibility. *Psych. Rev.*, Vol. 9, 1902, pp. 348-355.

point increases with the distance of the peripheral stimulus from that point. With the suggestive stimulus there is at first a tendency to resist the suggestion, but this diminishes as the suggestion is repeated. The resistance is most vigorous when the suggestion is contrary to the normal error, but ultimately the suggestion opposed to the normal tendency is most effective. The same person showed the highest degree of suggestibility in all of Pearce's tests, whether with visual, auditory or tactual stimuli.

The work which suggested the present investigation was that of Brand,[1] who tested the suggestive effect of printed mottoes on the reproduction of horizontal lines. These lines varied from 12 to 34 cm. in length and were represented by the interval between two pegs situated at a distance of 120 cm. from the eyes of the observer. The observer reproduced this interval by spacing two similar pegs on a ledge 40 cm. from his eyes. Of the four observers whose results are presented the first overestimated the distance when nonsense mottoes were shown, the second and third underestimated it, while the fourth reproduced it almost exactly. The effect of the "short" suggestion (mottoes containing the word "short," or "make short," or "make short enough") upon the first subject was to produce a slight negative error in the aggregate, while the "long" suggestion considerably increased the positive error. In the case of the second subject "short" suggestion caused a slight increase in the underestimation, while "long" decreased it. With both subjects the "long" suggestion was more effective than the "short." The fourth subject showed a positive error for "long" and an equal negative one for "short" suggestion. With all three of these subjects, therefore, the suggestion was positively effective. In the case of the third subject, however, "long" suggestion caused an increase in the underestimation, while "short" caused a decrease, *i. e.*, the effect of the suggestion was negative, the results being opposite to the nature of the suggestion. Here again the "long" suggestion was more effective than the "short."

More recently Smith and Sowton[2] have investigated the effect of what they called successive contrast. A modifying line varying from 2 to 20 cm. was shown and immediately afterward a standard line of 10 cm. was exposed. The length of the standard was marked off on a line already drawn on a sheet of paper. In all cases, both with and without the modi-

[1] Brand, J. E.: The Effect of Verbal Suggestion upon the Estimation of Linear Magnitudes. *Psych. Rev.*, Vol. 12, 1905, pp. 41-49.

[2] Smith, W. G. and Sowton, S. C. M.: Observations on Spatial Contrast and Confluence in Visual Perception. *Brit. Journ. Psych.*, Vol. 2, 1907, pp. 196-219.

fiers, the standard was underestimated, but for one of the two subjects modifiers of 2–10 cm. produced an average increase of 1.2 mm. in the estimation, while modifiers of 10-20 cm. caused an average decrease of 0.9 mm. That is, the shorter lines acted as a positive suggestion, the longer ones as negative.

EXPERIMENTAL

In the experiments now to be recounted the following apparatus was used. Upon a long table rested a black-lined box in the form of a truncated pyramid 8 × 12 cm. at the small end, 65 cm. square at the large end, and 185 cm. long. The large end was covered with black cardboard in the centre of which was an opening 25 cm. square, closed by a screen which could be raised and lowered at the pleasure of the operator. 15 cm. behind this screen was placed a frame to hold the cards upon which were drawn the forms to be reproduced. These cards were illuminated from the side by a four candle-power incandescent light, to secure constancy of illumination. The observer, seated at the end of the table, rested the forehead against a head-rest fastened to the small end of the box, and looked through the box at the cards. The latter were thus two meters from the eyes of the observer. The time of the exposure was two seconds.

Two kinds of suggestion were used, auditory and visual. The auditory suggestion consisted of a command, such as "make high," "make low," "make high enough," etc., or simply "high," "low," uttered in a firm tone of voice at the moment of exposure. The observers were requested to oppose no active resistance to the command, to allow their attitude to be as passive as possible so that the suggestion might have a chance to manifest its effect, yet they were asked to reproduce the figures as accurately as they could. For the visual suggestion a diamond-shaped figure 20 cm. long and 4 cm. wide (Plate I, Fig. XI) was shown on the frame, and immediately thereafter the form to be reproduced was exposed. As this diamond when shown in a vertical position was considerably higher than any of the forms, and as the shape of the figure was such as would probably cause an up and down movement of the line of regard, it was thought that it might serve as a "high" suggestion. On the other hand, when shown in a horizontal position the diamond-shaped figure gave a flattened out effect, so that it was called a "low" suggestion. To ensure this figure remaining in consciousness during the reproduction the observer was required to draw it with the greatest possible degree of accuracy as soon as the reproduction was made.

The forms decided on for reproduction were *A*. Triangles of different shapes and heights. *B*. Vertical point distances,

(1) Dots at given distances above the centre of a base line,
(2) Dots at like distances above another dot.

A. Triangles

Ten triangles of different shapes and heights were used, all having the same base of 10 cm. (See Plate I.) They varied from 49 to 100 mm. in altitude. Four were isosceles or nearly so, four were right or slightly acute, and two were obtuse, their apices projecting to the right of the base. The observer was given a sheet of paper 16×22 cm. with a base line of 10 cm. already drawn upon it, and was required to indicate with a pencil dot where the apex of the triangle would fall. Nine reproductions of each triangle were made with each kind of

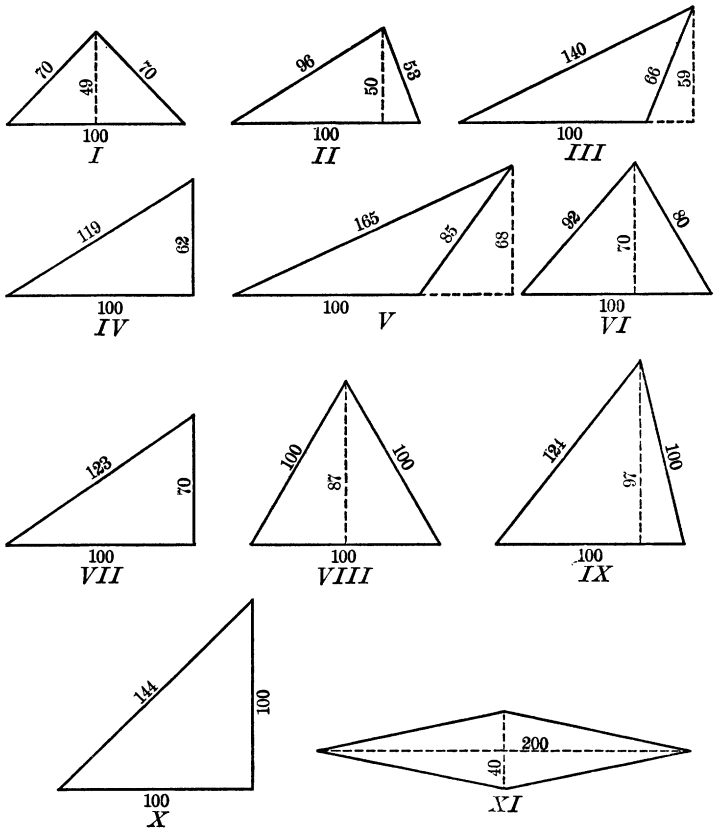

Plate I

The Arabic figures give the dimensions of the standard Triangles in millimeters.

suggestion, auditory and visual. The ten triangles were presented to the observer one after another in irregular order, and this constituted a series. Thus nine series composed a set. In order to obtain standards of reproduction for each observer without suggestion the first, fourth and seventh series of each set were given without suggestion, the triangles being presented in chance order. By taking the averages of these series as standards the practice element was practically eliminated. In the remaining series high or low suggestion was given in such a way that, while the order of the individual suggestions was quite irregular, when the set was finished each triangle had been shown three times with high suggestion and three times with low. Each leg of the reproduced triangle was measured and the altitude computed. This altitude was then compared with the altitude of the original triangle and the excess or deficiency expressed in millimeters as a positive or negative error. Six persons participated in this part of the experiment as observers, and are designated by the letters A, B, C, D, E and F.

Table I represents the average error in altitude of three reproductions of each triangle under the conditions of standard, high suggestion and low suggestion, for the two types of suggestion, auditory and visual, which were employed. The Roman numeral indicates the number of the triangle, and is followed by the actual altitude of each triangle expressed in millimeters. At the bottom of each column is indicated the algebraic sum of the average errors for all the triangles under the conditions indicated. This will be referred to as the aggregate error for each observer under the condition specified. To the right are columns showing the algebraic sum of the average errors of all observers for each triangle. This represents the aggregate error for each triangle under the conditions indicated. In the last column to the right is given the average error per observer for each triangle in the standard experiments, taken without regard to the direction of the error. This will be referred to as "average error of standard."

In inspecting this table it must be borne in mind that the observations of the auditory set were completed for all observers before the visual set was taken up, so that the latter tests were made several weeks later than the former. This fact, as well as the different attendant conditions (the one was taken in the midst of auditory, the other of visual suggestions) might be mentioned to account for the difference in standards which is observed in the two sets. If we try to compare these results of different observers for individual triangles we find great variation in the way the observers react to the same situ-

TABLE I. TRIANGLES

Auditory

No.	Alt.	A.			B.			C.			D.			E.			F.			Aggregate			Ave.
	mm.	St.	Sugg. H	Sugg. L	St.	Sugg. H	Sugg. L	St.	Sugg. H	Sugg. L	St.	Sugg. H	Sugg. L	St.	Sugg. H	Sugg. L	St.	Sugg. H	Sugg. L	St.	Sugg. H	Sugg. L	Error of St.
I	49	+9	+8	+1	−3	+13	−8	0	−2	−2	+10	+5	−3	+14	+9	+8	+2	−1	+1	+32	+32	−3	6.3
II	50	+2	+7	+5	−1	+6	−8	−3	−6	−7	+1	−5	−5	+1	+4	+2	−1	+2	−2	−1	+8	−15	1.5
III	59	+17	+18	+3	+2	+10	−2	−1	+6	−1	+7	−1	−6	+8	+15	+21	0	−1	−2	+33	+47	+13	6.
IV	62	+10	+9	+3	−2	0	−12	−1	−1	+6	+2	+2	−5	+7	+9	+3	−5	+4	−6	+11	+23	−10	4.3
V	68	+22	+18	+15	+3	+11	−9	+22	+1	+4	+1	+18	−7	+9	+18	+11	−2	+7	−3	+53	+73	+11	10.
VI	70	+11	+13	+10	+10	+8	−8	+4	−4	−4	+1	−1	−5	+10	+9	+4	+5	+7	+4	+41	+32	+1	7.
VII	70	+12	+6	+2	−10	+6	−12	−1	+1	−5	+8	+3	−6	+3	+6	−1	−1	−1	0	+11	+21	−22	5.8
VIII	87	+26	+8	+19	−4	+13	−9	+11	+1	+5	+7	+3	−8	+7	−1	+3	+2	+4	+4	+49	+28	+14	9.5
IX	97	+7	+9	+2	−9	+8	−20	−13	−8	−11	−10	−14	−10	0	+4	−3	−7	−11	−8	−32	−12	−50	7.7
X	100	−1	0	+5	−16	0	−28	−21	+4	−16	−8	−6	−15	+2	+3	+9	−12	−14	−7	−56	−13	−52	10.
Total		+115	+96	+65	−30	+75	−116	−3	−8	−31	+17	+4	−70	+61	+76	+57	−19	−4	−19	+141	+239	−113	

Visual

I	49	+5	+11	+6	+3	+15	−3	+3	+10	+9	+7	+5	+10	+2	+6	−11	+4	+4	+7	+24	+51	+18	4.
II	50	+4	+3	−1	+2	+20	+1	+3	+2	−2	+2	0	+3	+3	+2	+2	+1	+1	0	+15	+28	+3	2.5
III	59	+12	+3	+18	+5	+25	+10	+18	+14	+10	+7	−2	−5	+4	+4	−5	+2	+7	0	+48	+51	+28	8.
IV	62	+6	+8	+5	0	+16	+8	+7	+6	+12	+6	+3	−1	−2	−1	+2	−1	−1	+2	+16	+31	+28	3.7
V	68	+11	+31	+16	−3	+11	−7	+6	+15	+14	+7	+18	+23	+16	−21	+2	+4	+9	+6	+41	+63	+54	8.
VI	70	+11	+6	+11	−6	+14	0	+7	+8	+3	+2	−1	+4	+1	+2	+4	−2	0	+4	+13	+29	+26	5.
VII	70	+3	+5	+3	−2	+9	−8	0	+11	+13	+1	−4	+2	+3	−1	0	−5	−1	0	0	+19	+10	2.3
VIII	87	+13	+12	+3	0	+7	−4	+14	−1	+27	+13	+4	−1	0	−14	−6	+1	+3	+5	+41	+11	+24	7.
IX	97	−4	+5	−6	−11	+3	−23	+13	+4	−11	−8	−16	−15	−8	−9	−12	−5	−15	−7	−23	−28	−74	8.2
X	100	−3	+2	−9	−16	+2	−25	+19	−7	−2	−9	0	−7	0	−15	−7	−12	−12	+7	−21	−30	−43	10.
Total		+58	+86	+46	−28	+122	−51	+90	+62	+73	+28	+7	+13	+19	−47	−31	−13	−5	+24	+154	+225	+74	

ation. If we consider the aggregate error of all the observers for each triangle, however, some interesting things appear.

1. Triangles II, IV, and VII show the lowest aggregate as well as the lowest average error in the determination of the standards in both auditory and visual sets. These triangles were 50 mm., 62 mm. and 70 mm. in altitude, and their right base angles were 70°, 80° and 90° respectively. This agrees with the assertion frequently made by the observers that the right triangles seemed easier to reproduce and they felt that the results were more accurate than with the other triangles. In X, however, another right triangle with an altitude of 100 mm., the widest variation is shown, and the aggregate error is strongly negative. The next widest variation is found in V, an obtuse triangle with an altitude of 68 mm., where the aggregate error is as strongly positive. In general the obtuse triangles III and V were said by the observers to be the most difficult to reproduce and the results were felt to be the least accurate, owing, perhaps, to the lack of base line beneath the apical point. In triangles I, VI, VIII, and IX, which vary but little from isosceles, there is a considerable error both aggregate and average. In all cases, except the last, the aggregate error is positive, in IX, with an altitude of 97 mm., the error is as strongly negative.

2. If we consider the result of high and low auditory suggestion upon the aggregate error of each triangle, we observe that in all but three triangles (I, VI and VIII) the high suggestion produced an increase in the aggregate error over that of the standard, *i. e.*, was positively effective, and that in one of these three the amount remains the same. For the low suggestion the results are even more uniform, all triangles but one (X) showing a decrease below the standard. The total aggregate error for all the triangles shows an increase of 98 mm. above the standard for high suggestion and a decrease of 254 mm. below the standard for low suggestion.

3, The results for visual suggestion are not so uniform. Three triangles (VIII, IX and X) fail to show any increase for high suggestion, while four (IV, V, VI, and VII) fail to show a decrease for low suggestion. The totals for all triangles, however, show an increase of 71 mm. for high and a decrease of 80 mm. for low suggestion as compared with the standard.

In so far, then, we may conclude that in general the suggestions do affect the reproductions of the triangles, that the auditory suggestion is more effective than the visual, and that in the auditory set the low suggestion is more effective than the high.

But the chief interest of this investigation lies not in the

way in which this group of observers reacts as a whole to individual triangles, but rather in the effect of high and low suggestion upon the reactions of each observer. Here again we shall consider the nature and amount of the aggregate error of all the triangles for each observer in each situation.

1. Auditory set. Referring to Table I we note that the total aggregate errors for each observer are as follows:

TABLE II. AGGREGATE ERRORS. AUDITORY

		Suggestion	
	Standard	High	Low
A	+115	+96	+ 65
B	— 30	+75	—116
C	— 3	— 8	— 31
D	+ 17	+ 4	— 70
E	+ 61	+76	+ 57
F	— 19	— 4	— 19

An inspection of the standard shows that observers A, D and E exhibit a positive type of error, *i. e.*, tend to place the point higher than it should be. C in this particular set shows a slightly negative standard (—3), but as in all the other work C's standards are decidedly positive it is better to consider this as due to the abnormally large negative error which C shows in reacting to triangles IX and X, and to call C positive also. B and F are negative, *i. e.*, place the point too low.

Turning to the effect of the suggestion, we find that in every case the aggregate error for low suggestion lies below that for high, and in every case but one it lies below the standard. In the one exception (F) it just equals the standard. The amount of decrease below the standard varies from 0 to 87 (A 50, B 86, C 28, D 87, E 4, F 0). The low auditory suggestion, therefore, seems to have been effective with all observers. The high suggestion does not seem to have been so generally effective. In three cases (A, C, and D) the aggregate error fell below that for the standards, while only in the case of B (—30+75=105) did it rise far above the standard.

Visual set. The same types of reaction to the standards prevail here as in the above set. The low suggestion is effective in five cases in reducing the error below that for the standards. In the sixth case (F) there is a rise of 37. For the high suggestion the error fell below that of standards in three cases again (C, D, and E), and in all these cases it was even lower than the results for low suggestion. B again shows a strong rise (+150) above the standard.

In summing up the work on the triangles we may say that observer B alone showed striking susceptibility to the suggestion in all cases; that the susceptibility to low suggestion was

more general and more uniform than that to high; that A showed a considerable positive error throughout, and but for a few very low reproductions in the high suggestion would have shown a uniform susceptibility; that with three observers in each series any kind of suggestion, whether high or low, tended to reduce the estimate below that of the standards; and that in the visual series the reduction for high suggestion went even farther than that for low. Upon C, D, and E, therefore, it would seem that the vertical diamond-shaped figure did not act as a suggestion at all, but that its exposure before the triangle to be reproduced gave rise to successive contrast, *i. e.*, caused the following triangle to seem lower than it was. Yet the figure, when placed horizontally, was in as sharp contrast to the height of the triangles as when vertical, and in this situation its effect was in the nature of a low suggestion.

The observers were inclined to doubt whether either the auditory or the visual suggestion was having any effect upon their reproductions, but thought that if either did so it would be the auditory. Repeatedly they said that the visual suggestion merely bothered them, made them more uncertain in their reproductions, and increased their inaccuracy. Yet the results scarcely bear them out in this statement. The errors for visual suggestion are rather less in amount if anything than those for auditory suggestion.

At first there was a tendency for the auditory suggestion to arouse an attitude of expectant attention in the mind of the observer. At the command "make high" the observer involuntarily looked for a high triangle to reproduce. After a few trials, however, the conviction was established that there was no connection between the command and the triangle shown, and from that time on all expectancy was eliminated.

B. Vertical Point Distances

In the course of the experimentation with triangles it was frequently felt that the conditions of the experiment were complicated by the fact that the apex was not always in the same lateral position with reference to the centre of the base. A simplification was therefore decided upon, and two sets of experiments were carried out as follows.

1st. Dot above line. A base line 10 cm. long, bisected by a short stroke 2 mm. high, was drawn on each of ten cards. On each card, directly above the bisection, a dot was placed at a distance varying regularly from 2 cm. to 11 cm. from the line. These cards were so numbered from 1 to 10 that the distance from the point to the line in centimeters was always just one greater than the number of the card (*e. g.*, III = 4 cm., IX = 10 cm., etc.).

TABLE III. VERTICAL POINT DISTANCES

1. Dot above line. Auditory suggestion

No.	C.			D			E.			F.			Aggregate.			Ave.
	St.	Sugg. H	Sugg. L	St.	Sugg. H	Sugg. L	St.	Sugg. H	Sugg. L	St.	Sugg. H	Sugg. L	St.	Sugg. H	Sugg. L	Error of St.
I	+7	+2	−3	+1	+2	−1	+1	+4	+.3	+.3	−.3	+2	+9.3	+7.7	−1.7	2.3
II	−3	−4	−5	+6	+8	+5	+1	−1	−.3	−2	+3	−2	+2	+6	−2.3	3
III	+1	−3	+2	+7	+6	+5	+5	+4	+3	0	+2	+3	+13	+9	+13	3.3
IV	+7	+.3	+4	+3	+4	+1	+3	+7	+6	−4	+.3	+3	+9	+11.6	+14	4.3
V	+14	+14	+7	+2	+2	−.3	+15	+14	+18	−4	+3	+1	+27	+33	+25.7	8.8
VI	+17	+24	+16	+.3	−1	−2	+15	+29	+24	+2	+4	+3	+34.3	+59	+41	8.6
VII	+18	+13	+23	−2	−4	−4	+10	+15	+21	+4	+4	+8	+30	+28	+48	8.5
VIII	+13	+19	+18	+.3	+2	−.6	+20	+27	+19	−1	+1	+3	+32.3	+45	+39.4	9.3
IX	+32	+18	+7	−6	−13	−6	+24	+25	+27	−1	−4	+2	+49	+26	+30	15.8
X	+12	+21	+28	−13	−11	−10	+20	+28	+34	−5	−2	−3	+14	+36	+49	12.5
Agg.	+118	+107.3	+97	−1.4	−9	−12.9	+114	+152	+152	−10.7	+11	+20	+219.9	+261.3	+256.1	

2. Dot above dot. Visual suggestion

I	−.6	−3	+1	+8	+8	+7	+8	+3	+5	−3	−2	+.6	+12.4	+6	+13.6	4.9
II	+1	+12	+10	+8	+12	+11	+7	+5	+6	−1	+5	+4	+15	+34	+31	4.3
III	−2	+6	+3	+10	+11	+9	+12	+9	+16	−.3	+3	+1	+19.7	+29	+29	6.1
IV	+1.4	+5	+3	+9	+12	+16	+19	+18	+16	−2	+2	0	+27.4	+37	+35	7.9
V	−5	+5	−1	+5	+16	+8	+26	+18	+15	−5	+5	+6	+21	+44	+28	10.3
VI	+7	+6	+2	+10	+2	+5	+22	+29	+31	−8	+2	−3	+31	+39	+35	11.8
VII	−1	+1	+5	+6	0	+2	+22	+23	+20	−6	+3	−.6	+21	+27	+26.4	8.8
VIII	−2	−1	+9	+6	+.6	−4	+30	+31	+30	−7	−1	0	+27	+29.6	+35	11.3
IX	+2	+1	+2	+1	+3	−10	+29	+29	+35	−4	−.3	+3	+28	+33.3	+30	9
X	+10	0	+8	+1	−7	−.6	+18	+29	+38	−7	−8	−7	+22	+14	+38.4	9
Agg.	+10.8	+32	+42	+64	+57.6	+43.4	+193	+194	+212	−43.3	+9.3	+4	+244.5	+292.9	+301.4	

2nd. Dot above dot. On each of a like number of cards two dots were so placed that the conditions were the same as above except that the base lines were lacking.

These cards were observed through the box described above. In the first set the observer was given a sheet of paper with a 10 cm. line on it, bisected as the one on the card, and was asked to place a dot at the same distance above the bisection as the one shown on the card. In the second set the paper carried only a dot instead of the line. The procedure was the same as that for the triangles. Each set was shown to each observer nine times. The first, fourth, and seventh series were given without suggestion and the results for each card were averaged for the standards. The other series were given with high and low suggestion, the cards being taken at random, and now the odd numbers were given with high suggestion the even with low, now *vice versa*. It was intended to give both sets of dots with auditory and visual suggestion, but the work was interrupted when the dot above line set had been completed with auditory suggestion and the dot above dot set with visual. Thus the results are not directly comparable. Only observers C, D, E and F took part in the dot experiments. The average and aggregate errors are given in Table III. An inspection of the table reveals several interesting tendencies.

1. Standards. (1) Aggregates and average error for the different vertical distances. The aggregate error of all observers for each vertical distance is uniformly positive. This uniformity is much more marked than was the case with the triangles. Nor is it due altogether to the absence of results from A and B. This naturally raises the query whether the sides of the triangles, particularly of the higher ones, may not have something to do with the reduction of the error. Perhaps it is a case of overestimation of acute angles such as characterizes the Poggendorff and Zöllner illusions, the overestimation of the acute apical angle in this case causing a flattening in the appearance of the triangle. In some also a relation to the Müller-Lyer figure may be traced. To settle this question the present data are insufficient. It will be noted that both the aggregate errors and the average errors of the standards increase roughly with the increase in vertical distance, though the last distance (11 cm.) does not show the largest error in either set. Further it will be seen that the average error of the standards has a greater range and is more regular in its variation in the first set than in the second.

(2) Errors of individual observers. The same general types regarding the nature of the error in each observer were noted as in the work with triangles, *i. e.*, C, D, and E were positive, F negative. It is true. that in D's case the aggregate error

for all distances in the dot above line set is slightly negative (—1.4 mm.), but this is due to an exceptionally large negative error for the 11 cm. distance. Seven out of the ten distances show a small positive error.

The way in which the error manifests itself in the different observers is striking. C and E begin with a small positive or slightly negative error for the lesser distances in the dot above line and advance to a large positive error (+32 cm.) for the greater distances. E behaves in the same manner with the dot above dot, but C keeps a small error here and fluctuates about the zero point with a slight balance on the positive side. These facts are in accord with the introspection of the observers. Both C and E had a greater feeling of certainty in placing the dot at short distances from the base line. The farther they got from the base line the greater became their uncertainty. With E this was true of the dot above dot also. C, however, found it easier to record the distance between dots than between the dot and the base line. The base line formed a distraction and the tendency was to outline a whole triangle, comparing the relative lengths of altitude and base, rather than to note merely the distance between the dot and the base line. D showed a small positive error in the shorter and medium distances in both sets, and, in sharp contrast to C and E, tended to go over into a negative error in the greater distances. D found it harder when only the dots were given, for, she said, "when a line was given I could measure the distance from the line to the dot by the length of the line, but when only a dot was given I had no measure." The same tendency, however, to go over into a negative error in the greater distances was observed in both sets. F showed a prevailing negative error in both sets and this tended to increase slightly with the greater distances especially in the dot above dot set. She, like C, felt surer of the distance between the dots than between the dot and line, yet her aggregate error is less for the latter than for the former.

2. Auditory suggestion; dot above line. There is little indication that the suggestion had any considerable effect. With C and D the low suggestion is lower than the standard, but the high suggestion, while higher than the low, is likewise lower than the standard. The result of either suggestion is to lower the error, the low being the more effective. With E and F, on the other hand, the opposite tendency is observed. The high suggestion gives an error higher than the standard, but the low suggestion produces an error just as high or even higher.

3. Visual suggestion; dot above dot. Here D and E maintain the same relative tendencies which they showed in the

auditory series, the former showing standard, high, low in descending order, the latter in ascending. C here changes decidedly to the ascending order, while F goes from an aggregate error of —43.3 for standard to +9.3 for high suggestion and drops back to +4.6 for low suggestion.

Discussion

Without doubt the most potent factor in cases of suggestion is the arousal of an attitude of expectant attention. In the experiments of Small and Binet pains were taken to arouse the highest possible degree of expectancy, and the whole of the illusion is referable to this attitude. In Pearce's experiment the result is due to shifting the attention from one stimulus to another, the reaction representing the resultant of both. If the focal idea is sufficiently dominating, and the situation does not offer too glaring a contradiction, there is almost no limit to be set to the amount of the illusion. In the present experiment expectant attention was gradually eliminated from the consciousness of the observer, and an effort was made to determine to what degree the mere sensory stimulus unwittingly influenced the reproduction. We have seen that with auditory suggestion in the triangles the influence was considerable, with the visual suggestion it was less marked, while with the dots the results were so contradictory as to be difficult of interpretation. This is due not to the changes in the conditions so much as to the time and practice elements. A somewhat similar decrease in the effect of the suggestion after repetition is observable in Binet's final trial. In our own experiments it seems to be a case of the motor power of ideas. In the first set, where the method of procedure was relatively novel, the idea aroused by the suggestion was sufficiently vigorous to influence the placing of the dot. But as the investigation proceeded a twofold process of habituation took place. 1st. The habit of judging of the situation and placing the dot became more and more automatic, less affected by other idea groups. 2nd. The constantly reiterated suggestion, known to have no definite connection with the figure to be reproduced, roused an idea weaker and weaker in its motor power, until it had only a slightly disturbing or distracting effect upon the reaction. The observer thus became habituated to leaving this stimulus out of account.

Like Pearce, Brand, and Smith and Sowton we found striking individual differences in susceptibility to suggestion. Observer B was the most uniformly susceptible, followed closely by A. Observers D and F, on the other hand, show little sign of being affected by the suggestion even from the first.

Mention was made of the fact that Binet, and Smith and

Sowton found uniform and very striking negative errors in reproduction without suggestion, and that of Brand's subjects two were negative and but one positive. In our experiments, on the other hand, four observers are of the positive type and two negative, while the aggregates are strongly positive throughout. It must be remembered, however, that the other investigators employed horizontal distances while ours were all vertical. The difference in results may, therefore, be connected with the well known vertical-horizontal illusion, where if two lines of equal length, the one vertical, the other horizontal, be observed the vertical will appear the longer. Further, Brand found that in general the long suggestion was more effective than the short, whereas with us the low suggestion was more effective than the high. If we take this in connection with the prevailing types of error in the two cases the generalization would seem to be warranted that with the predominantly negative type the suggestion to increase the distance will be more effective, while with the positive type the suggestion to shorten the distance will have the greater efficacy. This is corroborated by an examination of the results for the individual observers in our tables.

SUMMARY.

1. In reproduction without suggestion the aggregate error for all point distances and all triangles except IX and X was positive, *i. e.*, the observers tended to place the dots too high.

2. In the series without suggestion the type of error remained constant for each observer in all sets. All the observers were of the positive type except B and F.

3. There were decided individual differences in susceptibility to suggestion. B was the most susceptible, D and F the least.

4. The suggestions were most effective in the first set of experiments (triangles with auditory suggestion), less so in the later ones.

5. Low suggestion was more effective for the positive type, less effective for the negative type, than high suggestion.